PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :
H02K 5/128, 5/124, 3/44
H02K 7/11

A1

(11) International Publication Number: **WO 93/08632**

(43) International Publication Date: 29 April 1993 (29.04.93)

(21) International Application Number: PCT/AU92/00571

(22) International Filing Date: 23 October 1992 (23.10.92)

(30) Priority data:
PK 9146 25 October 1991 (25.10.91) AU

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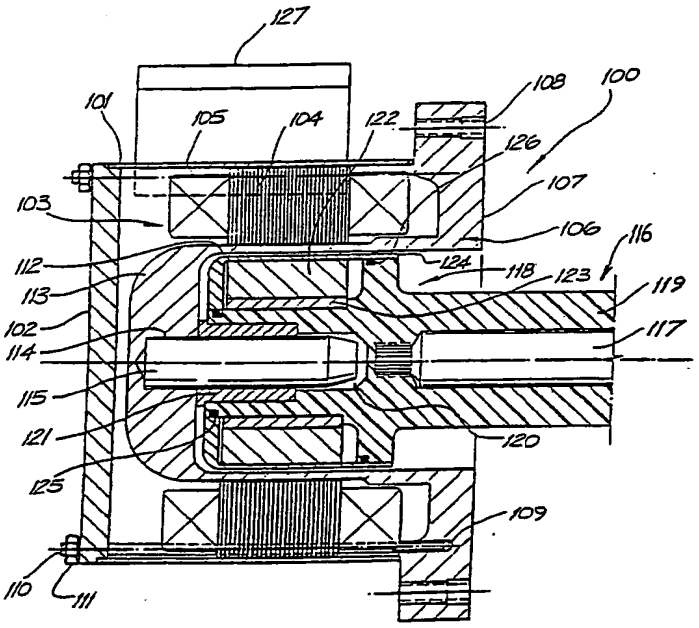
(81) Designated States: AT, AU, BB, BG, BR, CA, CH, CS, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, PL, RO, RU, SD, SE, UA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG).

Published
With international search report.

(54) Title: A MAGNETICALLY COUPLED MOTOR



(57) Abstract

A magnetically coupled motor (100) is disclosed having a stator (103) and a rotating armature (116) which couples to a shaft (117, 119). Interposed in a magnetic coupling between the stator (103) and armature (116), or between the motor (100) and the shaft (117, 119), is a closure member (106) which is connectable to an exterior chassis (101) of the motor (100) to hermetically seal the stator (103), or the motor (100), from the shaft (117, 119). This enables the immersion of the shaft in corrosive fluids without damaging the stator (103), or the motor (100).

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A MAGNETICALLY COUPLED MOTOR

Field of the Invention

The present invention relates to electric motors and, in particular, discloses a motor in which the rotational drive from the motor is internally magnetically coupled.

Background Art

In industry, it is often required that electrical machinery be operated in the vicinity of toxic, explosive and corrosive liquids and gases. Examples of such uses can be in chemical processing plants, and also, in particular in the processing and developing of photographic film.

In film processing, it is required to pass a ribbon of film through various developing solutions so as to develop the film. Typically, an elaborate gear drive mechanism is provided which is driven generally by a single electric motor. In such an arrangement, the motor can be positioned at a location distant from any corrosive liquids so as to ensure that the electric motor is not damaged by same with mechanical connections made from the drive to submerged driven rollers submerged in the developing solution.

However, the provision of the drive mechanism driven by a single motor is quite a complex task and accordingly, not inexpensive. It has been proposed to replace the complex drive mechanism by a substantially simplified mechanism which includes a plurality of motors each arranged at various locations within the system. However, such an arrangement necessitates the locating of the motors near corrosive solutions where normally, corrosion and leaking seals, would result in poor reliability or totally negate any advantage obtained from this direct connection. Also, where standard electrical motors are used in such an arrangement, slip or non-synchronous operation of the plurality can result, and therefore the function of the drive mechanism is not accurately reproduced.

Summary of the Invention

It is an object of the present invention to substantially overcome, or ameliorate, the abovementioned problems through.

In accordance with one aspect of the present invention there is disclosed an electric motor comprising:

a stator having at least one field winding;

an armature having a shaft extending therefrom, said armature being adapted to rotate upon excitation of said field winding(s);

an air gap across which a magnetic field extends; and

a closure member passing through said air gap and interconnecting with an outer casing of said motor to hermetically seal at least part of said motor.

In accordance with another aspect of the present invention there is disclosed an electric motor comprising:

a stator having at least one field winding;

an armature mounted for rotation about a fixed shaft under influence of a magnetic field established by exciting said stator;

a first set of magnets mounted on said armature;

a free shaft alignable with said fixed shaft and upon which are arranged a second set of magnets adapted to rotate in substantial synchronism with said first set of magnets due to magnetic fields therebetween; and

a closure member forming part of an outer casing for said motor and enclosing said armature and said stator, said closure member being located in a space separating said first and second magnets to thereby seal said armature and said stator from said free shaft.

Preferably, the armature comprises a third set magnets which cause rotation of the armature with a rotating magnetic field established by said stator. Alternatively, the armature comprises a winding which through excitation by the stator, causes rotation thereof.

Also preferably, the magnets comprise rare-earth materials.

In accordance with another aspect of the present invention there is disclosed an electric motor comprising:

a stator having at least one field winding;

an armature and connected to a free shaft and rotatable under influence of a magnetic field established by exciting said stator; and

a closure member forming part of an outer casing for said motor, said closure member being arranged to extend through an air gap separating said stator and armature to, in concert with said outer casing, seal said stator from said armature and free shaft.

In accordance with another aspect of the present invention there is disclosed an electric motor comprising:

a stator, an armature adapted to rotate upon excitation of said stator, and a shaft adapted to transmit rotational drive from said motor characterised in that at least part of said motor is hermetically sealed from said shaft by a closure member extending through a magnetic coupling between at least said shaft and said stator.

Brief Description of the Drawings

A number of embodiments of the present invention will now be described with reference to the drawings in which:

Fig. 1 shows a longitudinal cross-section through a motor of the preferred embodiment;

Fig. 2 is a cross-sectional of the motor of Fig. 1 in use; and

Fig. 3 is a longitudinal cross section of a motor of a second embodiment.

Best and Other Modes for Carrying Out the Invention

Referring to Fig. 1, an electric motor 10 is shown which includes a cylindrical casing 11, and an end plate 12 arranged at one end of the casing 11. Generally, the casing 11 can be manufactured of mild steel and the end plate 12 from aluminium, although other materials can be used.

Arranged on the interior wall of the casing 11, is a stator 20 of standard configuration and including iron core pole pieces 21 each having a corresponding stator field winding 22 wound thereabout. In the preferred embodiment, a six-pole stator is used.

Extending from the end plate 12 is a frusto-conical section 13 including a blind channel 14 formed along the longitudinal axis 17 of the motor 10. The channel 14 is configured to receive a shaft 30 which is fixed to prevent rotation by means of a pin, bolt or like device (not illustrated) insertable via an aperture 15 in the frusto-conical section 13. An armature 40 is mounted for rotation on the dead shaft 30 by means of a first bearing arranged above a step 31 on the shaft 30, and a second bearing 34 arranged below a second step 32. The second bearing 34 is retained from sliding along the shaft 30 by means of a retaining ring or circlip 35. The first bearing 33 is prevented from sliding along the shaft 30 by the arrangement of a support piece 41 mounted upon each of the bearings 33 and 34.

The support piece 41 is substantially tubular in shape, is formed from mild steel or iron and includes integral first and second

cylindrical portions 47 and 48 (respectively) interconnected by an annular flange 49. Mounted upon the first cylindrical portion 47 at locations adjacent the poles 21 are a corresponding number of permanent magnets 42 which are preferably comprise rare earth materials.

With this configuration, when the windings 22 of the stator 20 are energised by phase-displaced alternating current, a rotating magnetic field is established which acts upon the magnets 42 to cause rotation of the armature 40 about the dead shaft 30.

In the alternative configuration, those skilled in the art will appreciate that the magnets 42 of the armature 40 can be substituted for by an armature winding which can be excited for rotation in a similar manner.

As seen in Fig. 1, the dead shaft 30 extends only marginally beyond the second bearing 34 and the first cylindrical portion 47 ends at a location adjacent the end of the dead shaft 30. The annular flange 49, interconnects to the second cylindrical portion 48 which extends longitudinally away from the end of the shaft 30 and has a diameter greater than that of the first portion 47.

Arranged on the inside of the second cylindrical portion 48, and facing the longitudinal axis 17, are a number (e.g. twelve) of permanent magnets 43 which form part of a magnetic drive coupling to a free shaft 60.

The free shaft 60 is adapted to be connected to drive external equipment, an example of which is shown illustrated in Fig. 2. So as to be useful in corrosive environments, the free shaft 60 should be manufactured of materials that are corrosive resistant, antistatic and non-magnetic, such as PVC. Where the shaft 60 requires a strength not generally obtainable with plastics materials such as PVC, materials such as stainless steel, brass, or titanium can be used. In such an application, it is necessary that the shaft 60 be clad by a sleeve 61 (as illustrated) manufactured of corrosion resistive materials as indicated above. In the configuration of Fig. 1, where the end of the shaft 60 is exposed (adjacent the fixed shaft 30), the shaft 60 and sleeve 61 should both be manufactured of corrosion resistant materials, that can have differing properties.

Arranged at one end of the shaft 60, in the sleeve 61, are a plurality of magnets 64 complementing to the magnets 43 of the armature 40. The magnets 64 are arranged to face the magnets 43 and to be magnetically attracted thereby. By a balancing of the magnetic fields between the magnets 43 and the magnets 64, the shaft 60 is freely locatable along the longitudinal axis 17 in such a manner that the rotation of the armature 40 causes corresponding rotation of the free shaft 60.

The magnets 64 are positioned on a stepped portion of the sleeve 61 and are adhered to, and supported by, a cylindrical yoke 63 preferably manufactured from mild steel or iron. The yoke 63 acts to enhance the magnetic coupling between the magnets 64. The yoke 63 is secured to the sleeve 61 by a number of pins 62 which radially interconnect same. The magnets 64 and yoke 63 are covered by a cover piece 65 also manufactured of materials similar to the sleeve 61 and is sealed to the sleeve 61 by means of two O-rings 66 and 67. In the preferred embodiment, a 12-pole arrangement of magnets 43 and 64 is used, however other numbers, such as 10, are readily suitable.

So as to ensure that the interior of the motor 10 is not damaged by corrosive agents, a closure member 50 is provided to seal the end of the motor 10 opposite the end plate 12. The closure member 50 is associated with an annular end plate 51 so as to fully enclose the stator 20 and armature 40. The annular end plate 51 and closure member 50 are preferably manufactured of polypropylene or other materials similar in properties to the sleeve 61 with the latter extending from a location adjacent the periphery of the second portion 48 of the support piece 41, through an air gap between the magnets 43 of the armature 40 and the cover piece 65 of the free shaft 60, and extending to a blind hole 52 arranged to cap the free end of the dead shaft 30. The annular end plate 51 is provided with apertures 53 and 55 which are configured for securing the end plate 51 to the casing 11 and for mounting the motor 10 upon a chassis or support 99, and within which the free shaft 60 is rotatably mounted. For this, a further O-ring 69 is provided to hermetically seal the exterior of the motor 10 from the rotating shaft 60.

Referring to Fig. 2, the motor 10 is shown mounted upon the wall of a developing tank 70 such that the shaft 60 extends through an

aperture 71 arranged in the wall and supported clear of the wall by the spigot 68. The shaft 60 extends to a stub mount 72 on the opposite wall of the tank 70 and incorporates a number of rollers 73. A slave shaft 74 is configured in the bottom of the tank 70 and includes a number of slave rollers 75. A roll of photographic film 76 is wound about the rollers 75 and 73 such that they enter and exit from the developing solution 77 with which the tank 70 is filled. When the motor 10 is energised, the shaft 60 is configured to rotate and therefore pass the film 76 through the developing solution 77 at a predetermined rate.

As is seen from Fig. 2, the developing solution 77 is able to pass through the aperture 71 to envelop the end of the shaft 60 adjacent the magnets 43. In this configuration, the arrangement of the closure member 50 prevents the ingress of the developing liquid 77 into the casing 11. The O-ring 69 also prevents escape of the liquid 77 from the tank 70. Furthermore, the aperture 71 is dimensioned to approximate the diameter of the closure member 50 thereby permitting the shaft 60 and rollers 73 to be extracted from the tank 70 through the aperture 71.

It will be apparent to those skilled in the art that the foregoing arrangement, by use of non-corrosive materials such as polypropylene and PVC, prevents the ingress of corrosive liquids and the like into the casing 11 which may damage the windings 22, magnets 42 and 43 or the bearings 33 and 34. Also, the use of the sleeve 61 and cover piece 65 prevents corrosion of the rotating shaft 60 and the magnets 64.

It will also be apparent that the foregoing configuration provides for the magnetic coupling of the rotating armature 40 to the free shaft 60. Furthermore, the magnetic coupling between the magnets 43 and the magnets 64, is synchronous under no load and non-overload conditions, and should an overload load be applied to the shaft 60, the shaft 60 can free wheel. This prevents overtensioning of the photographic film when each of a plurality of the motors 10 is used in a corresponding drive shaft of a film processing apparatus.

Furthermore, the pull out force required to remove the shaft 60 and magnets 64 from the field of the magnets 48 is relatively low, about 2 kg force, so assembly and disassembly if required is not difficult.

The foregoing arrangement has a number of advantages, primarily in relation to the servicing of the attachment made to the motor 10 which, in Fig. 2, is represented by the shaft 60, spigot 68 and rollers 73, or for replacement of the motor 10. The attachment can be removed by sliding away, thus withdrawing, the male coupling, comprising items 61-67, from the field of the armature 40. Servicing of the attachment can then be performed.

The spigot 68 in Fig. 1 ensures concentricity of the male coupling 61-67 by itself being centralised within the closure member 50. Some longitudinal self centering (alignment) is achieved between the magnets 43 and 64 due to the magnetic fields. The attachment can also be fixed to the chassis of any device, in this case the tank 70.

Replacement of the motor without affecting the attachment or the corrosive or fluid environment on the attachment side of the chassis can be achieved either by removal in whole by removing fixings from the apertures 53 or in part, leaving the closure member 50 and the annular end plate 51 fixed in place on the chassis by removing the fixings (bolts) which pass through the end plate 12 via the apertures 55. This permits the removal of the motor 10 from the annular end plate 51.

It will be apparent that a variety of arrangements of the magnets 43 and 64 can be used. For example, the magnetic poles can be arranged either longitudinally, or co-axially. Also, adjacent magnets on each of the armature 40 and free shaft 60 are preferably arranged oppositely poled for maximum magnetic field and should there be a slip in rotation between the two, repulsive forces exerted by the adjacent magnets, will tend to compensate and take-up the slip by re-aligning the magnets.

Turning now to Fig. 3, an alternative embodiment of a motor 100 is shown. The motor 100 includes a tubular casing 101 within which is formed a stator 103 having iron core pole pieces 104 and corresponding stator field windings 105. A flat end plate 102 is configured to close one end of the casing 101. A terminal box 127 is shown mounted on the casing 101 which enables interconnection between an electrical supply and the stator windings 105.

The other end of the casing 101 is configured to be closed by a closure member 106 which is substantially bell-shaped and which includes an annular flat end 107 which includes fixing points 109 each

configured to receive a bolt 110 which extends through the casing 101 to the flat end plate 102 for securing by means of a nut 111. With this configuration, the stator 103 is completely sealed within the casing 101. The closure member 106 also includes a number of mounting apertures 108 with which the motor 100 can be mounted upon the chassis of an apparatus for which it is to drive. Such an apparatus can be a pump, for example.

The closure member 106 extends perpendicularly from the interior of the annular flat end 107 as a tubular thin walled section 112. The tubular section 112 extends immediately adjacent the iron core pole pieces 104 and terminates as a closing end 113 of relatively thick cross-section. As seen, the closing end 113 is positioned immediately adjacent the flat end plate 102 such that the closure member 106 provides an opening (from the right hand side of Fig. 3) into the motor 100 between the pole pieces 104.

This opening permits the insertion of a rotating armature 116 formed by a head portion 118 connected to a drive shaft 117. The rotating armature 116 is substantially identical to the male coupling member 60-67 of Fig. 1 in that it includes a corrosion resistant sleeve 119 which encloses the shaft 117 and also includes a plurality of magnets 122 complementing the pole pieces 104 and mounted about a soft iron core 123. The iron core 123 and magnet 122 are protected from corrosion by means of a magnet cover 124 which is sealed by two O-rings 125 and 126.

As seen, the closing end 113 includes a blind channel 114 into which is inserted a stub shaft 115 which is manufactured out of non-corrosive materials such as glass (quartz) or an extremely rigid plastics material. The stub shaft 115 is adapted to be inserted into a complementary blind hole 120 in the end of the head portion 118 to support the shaft 117 centrally within the closure member 116. A teflon bush 121 is provided in the entry of the blind hole 120 and acts as a bearing surface about which the head portion can rotate about the stub shaft 115. In this embodiment, the shaft 117 is manufactured of corrosive materials and therefore the sleeve 119 fully encloses the shaft 117 by capping the end of the shaft adjacent the blind hole 120.

In operation, the stator 103 when appropriately energised

establishes a rotating magnetic field which interacts with the magnets 122 to cause direct rotation of the armature 116 and the integrally connected drive shaft 117. It is apparent from Fig. 3 that the closure member 106 passes through an air gap separating the stator 103 and rotating armature 116.

Like the previous embodiments, it is preferred that the magnets 122 be manufactured of rare earth materials thereby permitting high levels of permanent magnetism to provide high efficiency. Unlike the previous embodiment, where only a relatively small amount of force is required to separate the magnetic coupling, provided between the magnets 43 and 64, in the embodiment of Fig. 3, a substantially larger force is required to separate the magnetic coupling between the magnets 122 and the pole pieces 104. In this manner, the motor of Fig. 3 is generally used in situations where permanent connection can be made, such as to drive the impeller of a pump, and limited disassembly is not necessary in order to normally operate the motor.

The foregoing describes only a number of embodiments of the present invention and, modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the present invention.

For example, materials other than polypropylene and PVC can be used that resist corrosion, prevent sparking, prevent contamination of liquid in contact (e.g. titanium, stainless steel, ceramics etc.).

Also, in alternative embodiments where the armature 40 has a sufficient diameter, the flange 49 interconnecting the cylindrical portions 47 and 48 becomes indiscernible or not required, particularly if other magnetic coupling arrangements are used.

Industrial Applicability

The present invention is applicable to situations where it is necessary to physically and/or electrically isolate the drive from the motor and the electrical componentry thereof. In particular, the invention has application in the petrochemical industry in view of the explosive hazards of such substances, and where corrosive substances are present.

CLAIMS:

1. An electric motor comprising:

a stator having at least one field winding;

an armature having a shaft extending therefrom, said armature being adapted to rotate upon excitation of said field winding(s);

an air gap across which a magnetic field extends; and

a closure member passing through said air gap and interconnecting with an outer casing of said motor to hermetically seal at least part of said motor.

2. A motor as claimed in claim 1, wherein said air gap forms part of a magnetic coupling between said armature and said shaft.

3. A motor as claimed in claim 2, wherein said magnetic coupling comprises a first set of permanent magnets arranged on said armature and on one side of said air gap, and a second set of permanent magnets arranged on said shaft on a remaining side of said air gap.

4. A motor as claimed in claim 2 or 3, wherein said armature comprises an induction means which, when excited by a field emanating from said windings, causes rotation of said armature.

5. A motor as claimed in claim 4, wherein said induction means comprises an armature winding into which electric current is induced by the emanating field to cause said rotation .

6. A motor as claimed in claim 4, wherein said induction means comprises a magnetic circuit formed from a third set of permanent magnets conductive of magnetic flux of the emanating field.

7. A motor as claimed in claim 3, wherein said armature comprises a support member upon which said induction means and said first set of magnets are located, said support member being mounted for rotation about a fixed shaft.

8. A motor as claimed in claim 7, wherein said fixed shaft extends from an end wall of said casing and said closure member extends from a wall opposite said end wall to a location substantially adjacent a free end of said fixed shaft.

9. A motor as claimed in claim 8, wherein said opposite wall is formed by an annular end plate, from the interior of which said closure member extends as a substantially cup-shaped partition between said first and second sets of magnets.

10. A motor as claimed in claim 9, wherein said closure member is adapted to be located about said free end of said fixed shaft.

11. A motor as claimed in claim 10, wherein said closure member supports said free end.

12. A motor as claimed in claim 3, wherein said shaft is free to rotate in substantial synchronism with said armature to provide a mechanical output of said motor.

13. A motor as claimed in claim 3, wherein said closure member seals said stator and said armature from said shaft.

14. A motor as claimed in claim 13, wherein said closure member comprises materials that are substantially resistant to corrosion.

15. A motor as claimed in claim 13, wherein said shaft comprises materials that render same substantially resistant to corrosion.

16. A motor as claimed in claim 13, wherein said shaft is susceptible to corrosion and is covered by a sleeve of material that is substantially resistant to corrosion.

17. A motor as claimed in claim 15 or 16 wherein said second set of magnets are positioned about one end of said shaft, are covered by a cap of corrosion resistant materials, and sealed against said shaft by at least one sealing means.

18. A motor as claimed in claim 17, wherein said sealing means comprises two O-rings.

19. A motor as claimed in claim 9, wherein said annular end plate is manufactured of corrosion resistant materials and is sealed against said closure member by an O-ring.

20. A motor as claimed in claim 14, 15, 16, 17,or 18 wherein said corrosion resistant materials comprises plastics materials.

21. A motor as claimed in claim 1, wherein said air gap forms part of a magnetic coupling between said stator and said armature.

22. A motor as claimed in claim 21, wherein said armature and said shaft are integrally formed, said armature comprising an induction means which, when excited by a field emanating from said windings, causes rotation of said armature and said shaft.

23. A motor as claimed in claim 22, wherein said induction means comprises an armature winding into which electric current is induced by the emanating field to cause said rotation.

24. A motor as claimed in claim 22, wherein said induction means comprises a magnetic circuit formed from a set of permanent magnets

inductive of magnetic flux of the emanating field.

25. A motor as claimed in claim 21, wherein said closure member extends from one end of said outer casing, past said stator to terminate adjacent an opposite end of said outer casing.

26. A motor as claimed in claim 25, wherein the terminal portion of said closure member supports a stub shaft extending therefrom into a complementary blind channel in said armature, to thereby support said armature and shaft within said motor.

27. A motor as claimed in claim 26, wherein said closure member is substantially bell-shaped and said armature is supported within said closure member by the shaft extending from the apex thereof, the periphery of the closure member closing said one end.

28. A motor as claimed in claim 22, wherein said closure member seals said stator and said armature from said shaft.

29. A motor as claimed in claim 28, wherein said closure member comprises materials that are substantially resistant to corrosion.

30. A motor as claimed in claim 28, wherein said shaft comprises materials that render same substantially resistant to corrosion.

31. A motor as claimed in claim 28, wherein said shaft is susceptible to corrosion and is covered by a sleeve of material that is substantially resistant to corrosion.

32. A motor as claimed in claim 30 or 31 wherein said induction means is positioned about one end of said shaft, is covered by a cap of corrosion resistant materials, and is sealed against said shaft by at least one sealing means.

33. A motor as claimed in claim 32, wherein said sealing means comprises two O-rings.

34. A motor as claimed in claim 28, 29, 30, 31, or 32 wherein said corrosion resistant materials comprises plastics materials.

35. Apparatus comprising:

a motor as claimed in any one of claims 1 to 35

36. Apparatus as claimed in claim 35 when dependent on any one of claims 1 to 20, further comprising at least one partition having an aperture through which said shaft passes, means for mounting said motor about said aperture, and a sealing means between said closure member and said partition and adapted to seal said aperture from said outer casing.

37. Apparatus as claimed in claim 35 when dependent upon any one of claims 21 to 34, further comprising a chassis portion to which said closure member can be affixed, and a sealing means between said closure member and said chassis portion adapted to seal said shaft and said armature from an exterior of said apparatus.

38. Apparatus as claimed in claim 36 or 37, wherein said sealing means comprises an O-ring.

39. An electric motor comprising:

a stator having at least one field winding;

an armature mounted for rotation about a fixed shaft under influence of a magnetic field established by exciting said stator;

a first set of magnets mounted on said armature;

a free shaft alignable with said fixed shaft and upon which are arranged a second set of magnets adapted to rotate in substantial synchronism with said first set of magnets due to magnetic fields therebetween; and

a closure member forming part of an outer casing for said motor and enclosing said armature and said stator, said closure member being located in a space separating said first and second magnets to thereby seal said armature and said stator from said free shaft.

40. An electric motor comprising:

a stator having at least one field winding;

an armature and connected to a free shaft and rotatable under influence of a magnetic field established by exciting said stator; and

a closure member forming part of an outer casing for said motor, said closure member being arranged to extend through an air gap separating said stator and armature to, in concert with said outer casing, seal said stator from said armature and free shaft.

41. An electric motor comprising:

a stator, an armature adapted to rotate upon excitation of said stator, and a shaft adapted to transmit rotational drive from said motor characterised in that at least part of said motor is hermetically sealed from said shaft by a closure member extending through a magnetic coupling between at least said shaft and said stator.

42. A motor as claimed in claim 41, wherein said magnetic coupling is contained within an outer casing of said motor.

43. A motor as claimed in claim 3, 6, or 24, wherein said permanent magnets comprise rare earth materials.

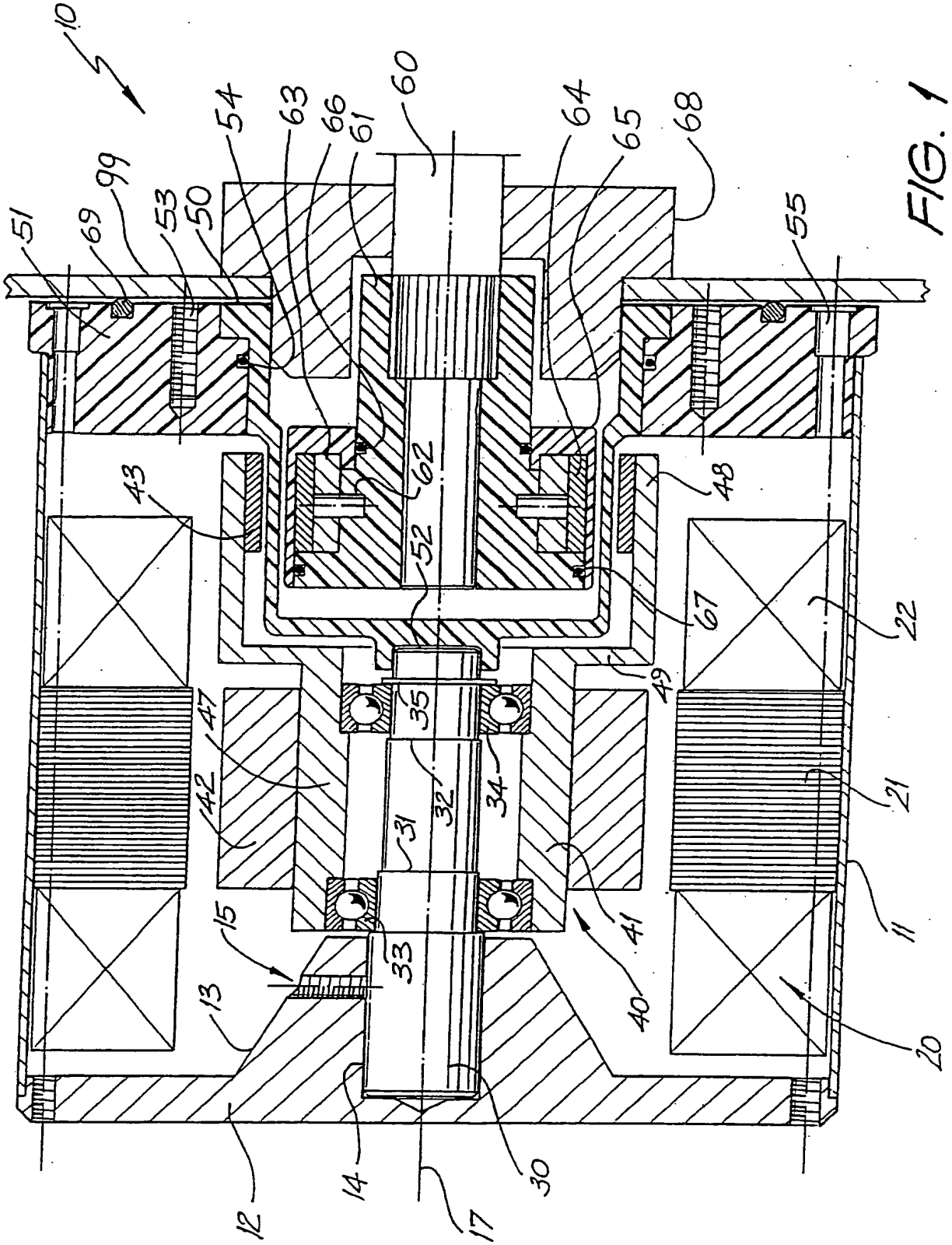
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FIG. 1

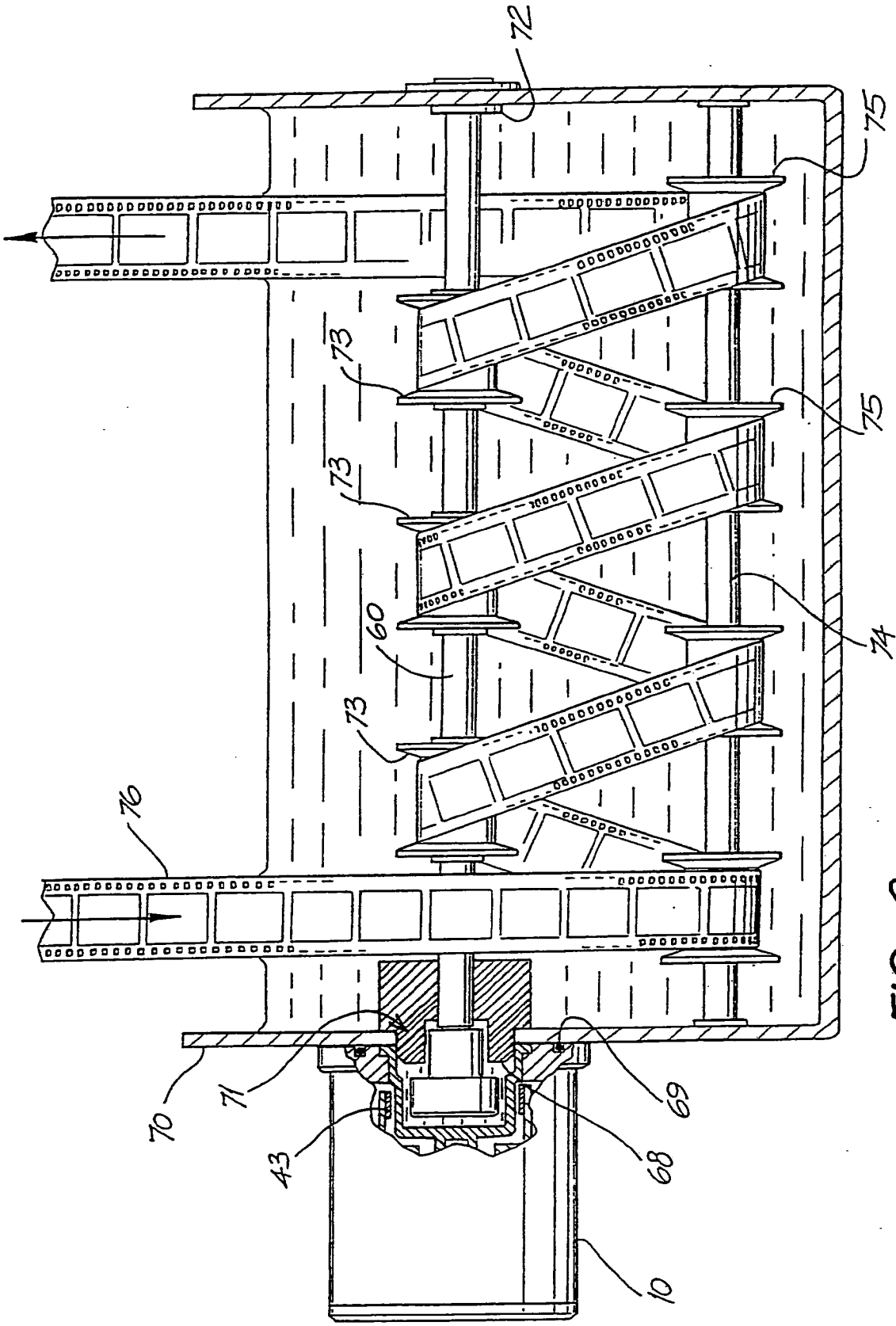

FIG. 2

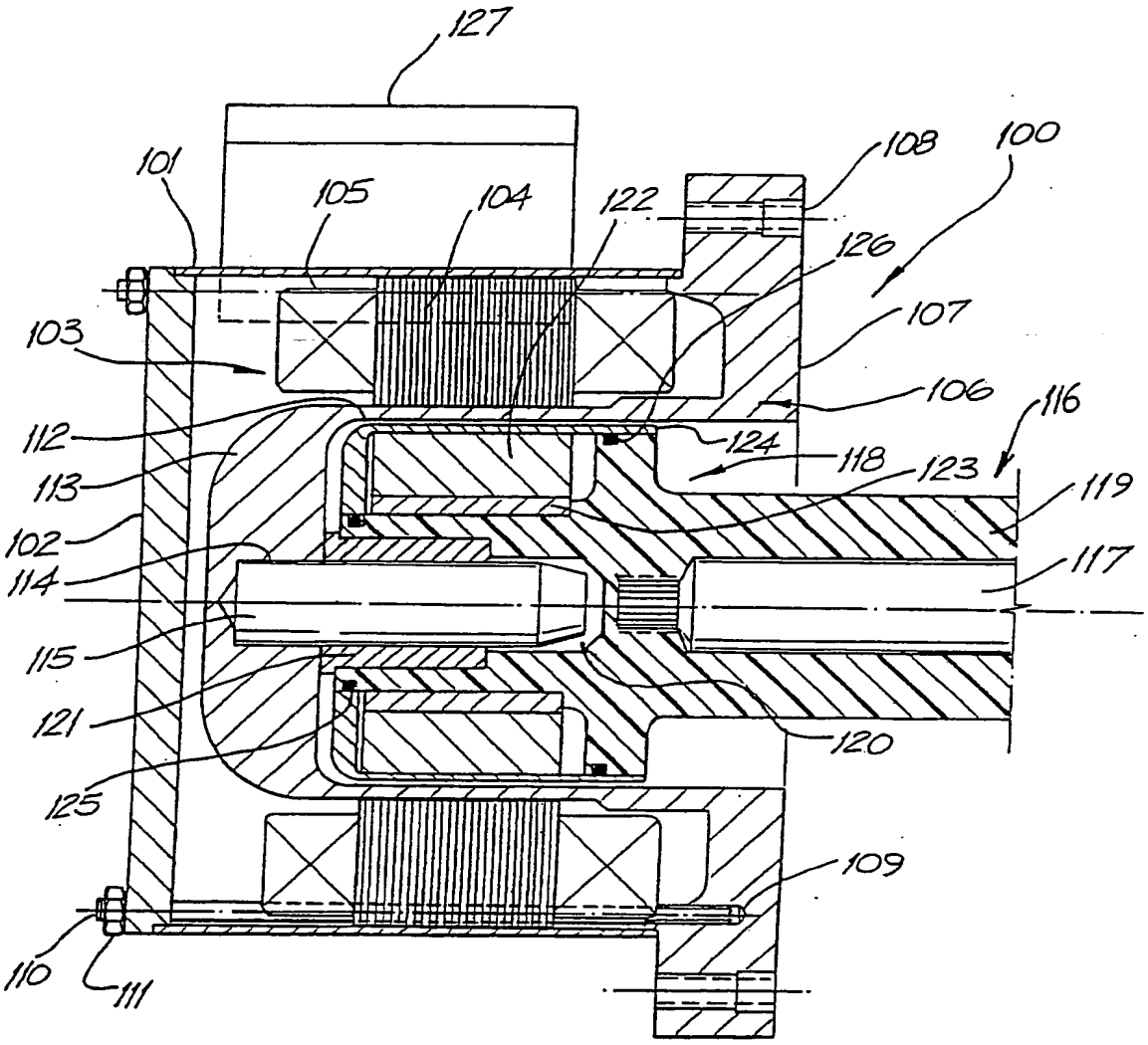
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FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU92/00571

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl.[5] H02K 5/128, 5/124, 3/44, 7/11

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: H02K 5/128, 5/124, 5/12, 5/10, 3/44

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above and H02K 7/11, 7/10

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	EP,A,145987 (ROBERT BOSCH GMBH) 26 June 1985 (26.06.85) abstract, Fig. 1	1,21-23,25-27, 35-38,40-42
X	AU,B,19063/83 (555704) (JACUZZI INC.) 22 March 1984 (22.03.84) page 4 line 21 to page 5 line 32, the figure	1-20,28-39,41-43
X	AU,B,39151/58 (228485) (AKTIEBOLAGET PUMPINDUSTRI) 8 January 1959 (08.01.59) page 2 line 12 to page 4 line 37, the drawing	1-20,28-39,41-43

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
24 December 1992 (24.12.92)	11 JAN 1993 (11.01.93)
Name and mailing address of the ISA/AU	Authorized officer
AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA	M. G Kraefft M.G. KRAEFFT
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	GB,A,179295 (BYRNE) 2 May 1922 (02.05.22) page 2 lines 59 to 107, Fig. 1	1-20,28-39,41-43
X	AU,B,1025/41 (116230) (JAMES BERESFORD & SON LIMITED) 17 December 1942 (17.12.42) whole document	1,21-23,25-27, 35-38,40-42
X	GB,A,1184176 (UNELEC) 11 March 1970 (11.03.70) whole document	1-8,12-18,20, 28-39,41-43
X	AU,B,2838/61 (246149) (H. HOLLESENS FABRIKKER A/S) 28 March 1963 (28.03.63) whole document	1,21-23,25-27, 35-38,40-42
X	AU,B,33359/50 (151570) (IMMOVILLI) 25 May 1950 (25.05.50) whole document	1-20,28-39,41-43

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This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	145987	DE	3345581	US	4614887		
AU	19063/83	BR	8305012	CA	1200271	DE	3368827
		EP	105234	ES	525633	JP	59072954
		MX	153951	NZ	205576	US	4539498
		ZA	8306771				
GB	1184176	CH	471327	DE	1653781	DE	1728406
		DE	1728405	DE	1788107	ES	337828
		NL	6703625	GB	1184420	GB	1185300

END OF ANNEX